Lymphovenous Anastomosis for the Treatment of Thoracic Duct Lesion: A Case Report and Systematic Review of Literature

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Abstract: BACKGROUND Chylous leak is an uncommon complication after head and neck surgery and typically results from a lesion of the thoracic duct (TD). Beside conservative treatment, different minimally invasive and surgical procedures exist, of which almost all lead to a total closure of the TD. METHODS We report on a rare case of microsurgical lymphovenous anastomosis to treat a TD lesion. An additional systematic review on surgical procedures to treat TD lesions with special attention to lymphovenous anastomoses was performed according to the PRISMA guidelines. RESULTS A 52-year-old patient with a chylous fistula after modified radical neck dissection was successfully treated by a lymphovenous anastomosis of the TD and external jugular vein with additional coverage by sternocleidomastoid muscle flap. The patient showed a complete resolution of chylous leak with an uneventful postoperative course.The systematic search of literature yielded 684 articles with 4 case reports on lymphovenous anastomosis in chylous leak with a high success rate. Other surgical techniques include transcervical, thoracoscopic, or video-assisted thoracoscopic TD ligation, either alone or combined with a local muscle flap. CONCLUSIONS Lymphovenous anastomosis of the TD is a feasible and safe technique allowing for treatment of cervical TD lesions, especially if minimally invasive procedures fail. Compared with other techniques, lymphatic circulation can successfully be maintained.

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A Case Report and Systematic Review of Literature

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Background: Chylous leak is an uncommon complication after head and neck surgery and typically results from a lesion of the thoracic duct (TD). Beside conservative treatment, different minimally invasive and surgical procedures exist, of which almost all lead to a total closure of the TD.

Methods: We report on a rare case of microsurgical lymphovenous anastomosis to treat a TD lesion. An additional systematic review on surgical procedures to treat TD lesions with special attention to lymphovenous anastomoses was performed according to the PRISMA guidelines.

Results: A 52-year-old patient with a chylous fistula after modified radical neck dissection was successfully treated by a lymphovenous anastomosis of the TD and external jugular vein with additional coverage by sternocleidomastoid muscle flap. The patient showed a complete resolution of chylous leak with an uneventful postoperative course.

The systematic search of literature yielded 684 articles with 4 case reports on lymphovenous anastomosis in chylous leak with a high success rate. Other surgical techniques include transcervical, thoracoscopic, or video-assisted thoracoscopic TD ligation, either alone or combined with a local muscle flap.

Conclusions: Lymphovenous anastomosis of the TD is a feasible and safe technique allowing for treatment of cervical TD lesions, especially if minimally invasive procedures fail. Compared with other techniques, lymphatic circulation can successfully be maintained.

Key Words: lymphovenous anastomosis, thoracic duct lesion, chyle fistula, lymphovenous bypass

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Chylous fistula typically results from an iatrogenic lesion of the thoracic duct (TD) or its tributaries during head and neck surgery such as neck dissection, pharyngectomy, esophagectomy, or thyroidectomy. Diagnosis is proven by milky appearance of the drainage fluid. An additional analysis of the amount of triglycerides and chylomicrons confirms diagnosis.

Chylous leakage is an uncommon complication with an incidence of 0.6% to 1.4% after central neck dissection and 4.5% to 8.3% after lateral neck dissection.[1–4] Because of its anatomy, lesions of the TD have a higher incidence after left-sided neck dissections. Moreover, the incidence of chylous leaks positively correlates with the extent of initial surgery as well as the presence of a metastatic lesion around the junction of the internal jugular vein and subclavian vein.[5,6]

Although, in absolute terms, incidence rates are low, the consequences of chylous leaks can be severe. High-output chylous fistula or a long duration causes loss of fluids, albumin, lymphocytes, and calories that may lead to immunosuppression and infection-related complications, and is associated with high morbidity and mortality. Thus, prompt diagnosis and treatment is essential.

Unfortunately, there are no treatment guidelines up to now, making it difficult for clinicians to choose the right management from a plethora of treatment modalities.

Generally, the first-line approach focuses on conservative management that includes low-fat diet with medium-chain triglycerides or total parenteral nutrition to decrease the production and flow of lymph and chyle.[7] Since Ulibarri's[8] first report in 1990, somatostatin analogs such as octreotide have also been used for the same reason. Its oral intake reduces the excretion of lymphatic fluid by acting on vascular somatostatin receptors.[9,10]

Regarding minimally invasive treatment modalities, percutaneous TD embolization and therapeutic lymphography have been reported with good success rates between 70% and 88%.[11,12] Surgical procedures include TD ligation, either by a cervical or thoracoscopic approach, as well as locoregional flaps and microsurgical lymphovenous anastomosis. However, the timing to change procedure is still a matter of debate and depends on the output and the overall condition of the patient.

The present review focuses on surgical procedures to treat TD lesions with special attention to reconstruction of the lymphatic flow into the venous system using lymphovenous anastomoses. Given a very small number on lymphovenous anastomoses in this setting up to now, we present a case of a 52-year-old patient with cervical TD fistula that was treated in our department.

CASE REPORT

A 52-year-old male patient presented with a chylous fistula after modified radical neck dissection levels II to V of the left side. He had been diagnosed as having left hypopharyngeal cancer with lymphatic metastasis 10 months before, followed by radiotherapy with 60 Gy of the tumor and 54 Gy each of both cervical lymphatic pathways as well as 3 cycles of chemotherapy with cisplatin. Although radiochemotherapy could only achieve a partial response, the patient underwent modified radical neck dissection levels II to V of the left side. During surgery, an unexpected metastatic infiltration of the inner jugular vein was discovered. The vein had to be resected in this area to excise the whole tumor. During the postoperative course, a milky wound secretion of 50 to 170 mL/d could be observed (Fig. 1A). An additional assessment of chylomicrons confirmed diagnosis of a chylous fistula.

On day 5, a transnodal ascending lymphangiography was performed. Lymphangiography demonstrated the chylous leak in medial aspect of the supraclavicular fossa. Because of the absence of a cisterna chylii, a percutaneous access to the TD was not possible (Fig. 1B). Because the secretion via the fistula was not more than 500 mL/d and the wound was closed, conservative treatment based on a low-fat median-chain triglyceride diet and an additional treatment with octreotid was continued and the liquid was punctures repetitively. Five weeks postoperatively, the patient experienced a wound breakdown with now continuous secretion of chylous fluid from the wound.

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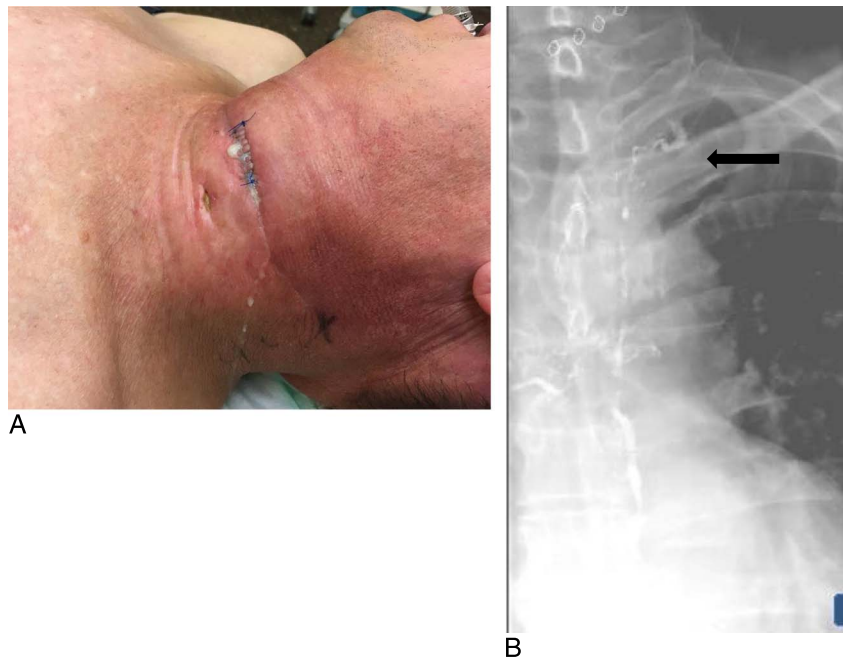

FIGURE 1. A, Thoracic duct lesion was recognized by a typical milky wound secretion early in the postoperative course. B, The transnodal ascending lymphography showed a TD lesion (black arrow).

Based on this, surgical treatment was indicated to revise and close the wound. A plan was made to attempt to visualize the TD lesion and, if feasible, perform a reconstruction of lymphatic flow using lymphovenous anastomosis.

The patient received 250 mL of high-fat cream via a gastric tube after intubation and approximately 1 h before preparing the TD to better visualize the chylous leak. The wound was reopened and a large amount of coagulated chyle encountered. After cleaning the wound, the carotid artery and the transected TD underneath could be identified (Fig. 2A). The external jugular vein was still present and mobilized to tunnel it underneath the sternocleidomastoid muscle reaching the TD lesion. A lymphovenous anastomosis was performed using nylon 10/0 interrupted

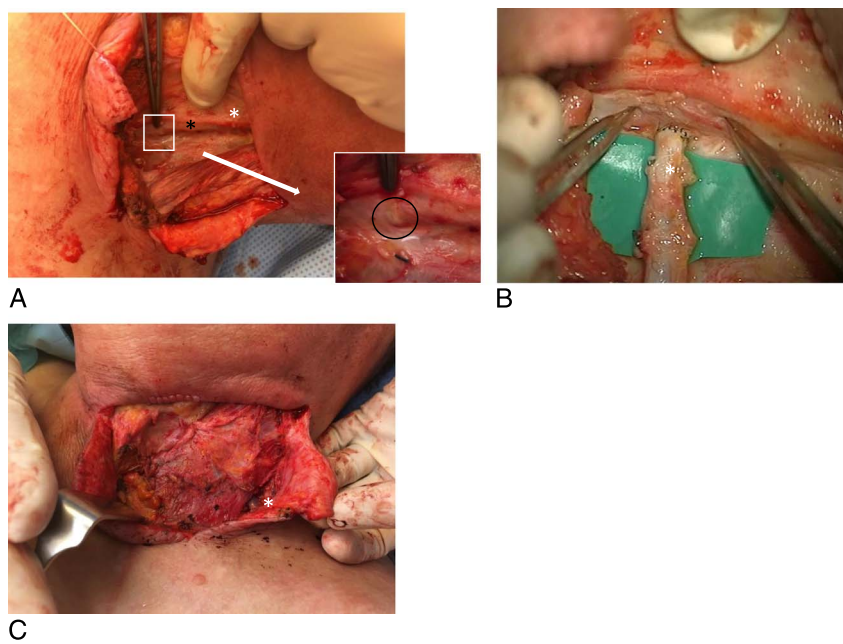

FIGURE 2. A, Intraoperative findings during revisional surgery showing the carotid artery (white asterisk), vagal nerve (black asterisk), and lumen of the severed TD (white square). B, End-to-end anastomosis of the TD and external jugular vein was performed, and a rapid "washout" was observed (white asterisk). C, Coverage with a sternocleidomastoid flap, with external jugular vein being visible (white asterisk).

FIGURE 3. Postoperative result after 4 months.

sutures. After opening of the clamps, a positive "washout" was observed owing to sufficient lymphatic flow over the anastomosis (Fig. 2B). The lymphovenous anastomosis then was covered with a sternocleidomastoid flap (Fig. 2C). A drain was placed close to the anastomosis to monitor fluid output.

In the postoperative course, there was no more chylous fluid via the drain and it was removed after 7 days. Wound healing was slightly prolonged because of the radioderm of the skin with complete wound closure after 5 weeks, but no fluid secretion. The patient was able to go on an overseas vacation and retuned after 4 months with a fully closed wound (Fig. 3).

METHODS

We performed a systematic review in accordance to the PRISMA guidelines. A review protocol was designed and registered on PROSPERO, the international prospective register of systematic reviews (https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=120242).

A literature research was conducted on December 17, 2018, using the following databases: MEDLINE, Embase, Cochrane, and Web of Science. Language was restricted to English and German. There was no time restriction. The following search terms were used: thoracic duct injury or thoracic duct lesion or chylous fistula or chyle fistulization or chyle leak and lympho-venous anastomosis or lympho-venous bypass or lympho-venous shunt or microsurgery or microsurgical or thoracic duct ligation or surgery or surgical. For further search details of the systematic review, see the Appendix (Supplementary Material http://links.lww.com/SAP/A448).

Two authors performed review of publications. Articles were selected based on inclusion and exclusion criteria. The inclusion criteria were as follows: retrospective studies, case reports, or case series on lymphovenous anastomosis, TD ligation/suture, or locoregional flaps to treat chyle/lymph fistula. Clinical studies on conservative treatment and minimally invasive techniques were excluded. Reviews and experimental research (ie, anatomical/experimental studies and animal studies) were not considered except when an additional case report was presented. Disagreement between the 2 reviewers concerning the inclusion of particular studies was resolved in consensus with the other reviewer.

Selected studies were included for detailed analysis and data extraction. The parameters for data extraction were the following: number of patients, cause of TD lesion, mean drain output, mean duration to revision surgery, mean follow-up, and either complete remission or recurrence. An additional narrative synthesis was included for studies/case reports on lymphovenous anastomoses in TD lesions.

RESULTS

The systematic search yielded 684 articles after removal of duplicates. After review of title and abstract, 41 articles were included in full-text review. Based on the inclusion criteria, 20 articles were finally selected. The detailed selection process is shown in Figure 4.

We identified 4 case reports on anastomosis between the TD and the venous system (Table 1). In the study by Veziant et al,[13] a 49-year-old woman with a TD cyst received side-to-side anastomosis between

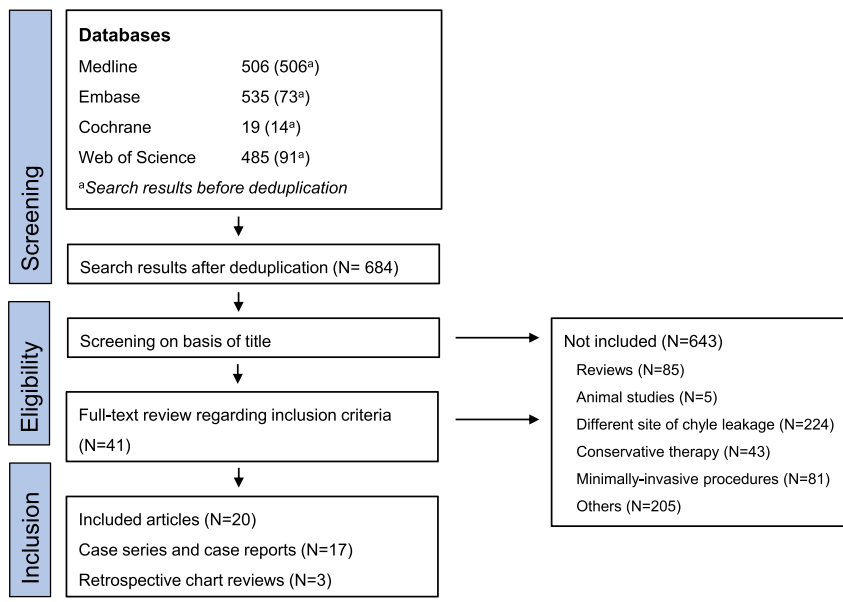

FIGURE 4. Systematic review of the literature.

TABLE 1. Lymphovenous Anastomosis in TD Lesions

Author (Year)	Study Design	N	Preoperative Condition	Operation	Mean Follow-up, y	Outcome
Veziant et al[13] (2015)	Case report	1	TD cyst	Side-to-side anastomosis of cyst and IJ	3	Complete resolution
Yuan et al[14] (2016)	Case report	1	Esophagectomy due to squamous cell carcinoma	End-to-side anastomosis of TD and AV	3	Patent anastomosis in LA
Weissler et al[15] (2018)	Case report	2	Chylothorax secondary to cardiac surgery Case 2: revision of anastomosis	End-to-end anastomosis of TD and vein	0.1	Case 1: patent anastomosis in LA
Miller et al[16] (2019)	Case report	1	TD obstruction with generalized lymphedema Patent anastomosis in LA	End-to-end anastomosis of TD and EJ	0.5	Improvement of lymphedema

AV, azygous vein; EJ, external jugular vein; IJ, internal jugular vein; LA, lymphangiography.

the cyst and the internal jugular vein leading to complete resolution without postoperative complication or recurrence.

A further case was reported by Yuan et al,[14] who performed end-to-end anastomosis between the TD and the azygous vein during esophagectomy in a 62-year-old patient with squamous cell carcinoma of the esophagus. The patient had an uneventful postoperative course without signs of a chylous leak. Lymphangiography 3 years after the operation showed a patent lymphovenous anastomosis.

Weissler et al[15] reported on 2 infants with chylothorax secondary to cardiac surgery who received end-to-end anastomosis of the TD and vein. In a 6-week-old boy, treatment led to full recovery and a patent lymphatic flow in lymphangiography after surgery. In the second case, a 4-month-old boy had to undergo revision of lymphovenous anastomosis once. Afterward, patent lymphatic flow was also confirmed by lymphangiography, but the patient died of an ischemic stroke in the further course.

In the study by Miller et al,[16] a 21-year-old patient presented with generalized lymphedema due to an obstruction of the TD after implantation and explantation of vagal nerve stimulator. He received scar lysis, end-to-end anastomosis of the TD and external jugular vein, and end-to-side anastomosis of a lymphatic vessel and internal jugular vein. Although lymphangiogram demonstrated blockage of TD before surgery, a patent anastomosis could be confirmed 3 months postoperatively. Thus, a significant improvement of lymphedema with a weight loss of 21% was observed.

Despite heterogeneity between the case reports, we can conclude that lymphovenous anastomosis was successful in all 5 patients with a mean follow-up of 1½ years and without reported surgery-related complications or worsening of initial symptoms.

In the past, surgical treatment of TD fistula also included the use of local muscle flaps, either alone or additional to ligation or suture of the TD. From 1990 to 2009, 9 patients received coverage with a local muscle flap, of which 7 were designed as sternocleidomastoid flap (Table 2).[17,19,20] In the remaining 2 patients, a local pectoralis major muscle flap was performed. In 55% of the cases, surgery included a ligation or suture of TD fistula before performing the flap.[18] In the study by de Gier et al,[18] fibrin sealant was applied instead and the wound was covered by pectoralis muscle flap and split skin graft. A complete resolution of symptoms was observed in 3 of 4 included studies.

After surgery, Lorenz et al[20] reported on 5 patients with recurrence of lymph fistula. Of these, 4 had received TD ligation, with an additional muscle flap in 1 patient. In the fifth patient, no source of lymphatic secretion had been identified during reoperation.

A thoracoscopic, video-assisted thoracoscopic, or transcervical TD ligation is a further option to treat cervical chylous leaks. Our systematic literature research revealed 11 relevant case reports[21–31] and 1

TABLE 2. Muscle Flaps in TD Lesions

Author (Year)	Study Design	N	Cause of TD Lesion	Mean Drain Output L/24 h	Mean Duration to 2nd Surgery, d	Operation	Mean Follow-up, y	Outcome
Anderl et al[17] (1996)	Case report	1	Supraclavicular metasasectomy	NA	NA	TD ligation + SCM	0.6	Complete resolution
de Gier et al[18] (1996)	Retrospective chart review	2 (of 11)	Left lateral neck dissection	4.2	23	Fibrin sealant + PM + split skin graft	NA	Complete resolution
Wechselberger et al[19] (1998)	Case series	4	Neck surgery	NA	NA	TD ligation + SCM	1.5	Complete resolution
Lorenz et al[20] (2010)	Retrospective chart review	10 (of 29)	Thyroidectomy surgery and neck dissection	0.3	NA	n = 7: TD ligature and/or suture + hemostyptic fleece (+ muscle flap in 1 case)		n = 5: complete resolution
						n = 2: hemostyptic fleece n = 1: muscle flap	NA	n = 5: recurrence of LF

LF, lymph fistula; PM, pectoralis major muscle flap; SCM, sternocleidomastoid muscle flap.

TABLE 3. TD ligation

Author (Year)	Study Design	Cause of TD Lesion	Mean Drain Output L/24 h	Mean Duration to TD Ligation, d	Surgical Approach	Mean Follow-up, y	Outcome
Abdel-Galil et al[21] (2009)	Case report	Left LND	>1	9	VATS	NA	Complete resolution
Gunnlaugsson et al[22] (2004)	Case report	Left LND	Case 1: 3–4	4	TS	3.6	Complete resolution
		Case 2: seroma	Approximately 210				
Ikeda[23] (2014)	Case report	Thyroidectomy + bilateral LND	1	11	TS	NA	Complete resolution
Kent et al[24] (1993)	Case report	Thyroidectomy + thymectomy + left LND	NA	Approximately 180	TS	NA	Complete resolution
Kumar et al[25] (2004)	Case report	Resection of left-sided brachial plexus neurofibroma	1–1.2	6	VATS	NA	Complete resolution
Park et al[5] (2018)	Retrospective chart review	Thyroidectomy ± CND ± LND	0.87	4.7	Transcervical (in 26 of 131 cases)	NA	Complete resolution
Shirakawa et al[26] (2015)	Case report	Pharyngolaryngoesophagectomy + left LND	>1	35	TS	NA	Complete resolution
Takase et al[27] (2014)	Case report	Pharyngolaryngectomy + bilateral LND + cervical TD ligation	1	28	VATS	NA	Complete resolution
Teksoz et al[28] (2017)	Case report	Thyroidectomy + bilateral LND + CND	1.5	31	TS	NA	Complete resolution
Tenny et al[29] (2018)	Case report	Right LND	0.4	48	VATS	0.1	Complete resolution
Van Natta et al[30] (2009)	Case report	Case 1: left CA to SA bypass	0.5	14	VATS	NA	Complete resolution
		Case 2: resection of tonsillar carcinoma and JV	0.1				
Wilkerson et al[31] (2014)	Case report	Left LND	5	6	TS	NA	Complete resolution

CND, central neck dissection; LND, lateral neck dissection; TS, thoracoscopic; VATS, video-assisted thoracoscopic.

retrospective chart review[5] on TD ligation (Table 3). In total, 7 patients received a thoracoscopic ligation of the TD between 1993 and 2018. Six patients had a video-assisted thoracoscopic ligation, and in 26 patients, a transcervical approach was used. The mean drain output before revision surgery was 1.5 L (range, 0.3–5 L). On average, TD ligation was performed 45 days after initial surgery (range, 4–210 days) with a success rate of 100%. The retrospective study, published by Park et al,[5] included 131 patients with chyle leakage after thyroidectomy and neck dissection. In 26 patients, transcervical TD ligation was necessary during the further course. Notably, they observed no chyle leakage after right lateral neck dissection, which is equivalent to 10 of 11 included case reports in which chyle leakage occurred after surgery of the left neck.

DISCUSSION

We report on a rare case of successful lymphovenous anastomosis to treat a TD fistula after neck dissection. Lymphovenous anastomosis provided definitive reconstruction of the TD and restored normal lymphatic drainage. Although the literature is limited to a few case reports so far, a high success rate without recurrence in all cases emphasizes its significance in the treatment of TD lesions.

To our knowledge, lymphovenous anastomoses between TD and venous system have been performed to treat chylothorax, TD cyst, TD obstruction, or central conducting lymphatic anomalies. The latter is a rare disease that was not identified by our systematic research because of variable clinical manifestations, such as chylous ascites, protein-losing enteropathy, chylous pericardial effusion, vaginal chylorrhea, and so on. Taghinia et al[32] conducted a retrospective study, with 14 patients with central conducting lymphatic anomalies receiving lymphovenous anastomosis of the TD and a vein that led to complete remission of symptoms in 5 patients. Given that 50% of patients did not have any improvements, the authors supposed that the abnormalities of the lymphatic system are not only limited to the TD terminus and might be further associated by insufficient peristalsis of the lymphatic system. Thus, the indication to perform lymphovenous anastomosis must be assessed thoroughly.

In the past, patients who had failed conservative treatment received either thoracoscopic TD ligation or minimally invasive procedures. Based on 11 identified publications on thoracoscopic TD ligation in cervical TD lesions, it seems to be a safe surgery with complete resolution of chylous leak without reported surgery-related complications. Nevertheless, the function of the TD has to be kept in mind, especially in patients with liver cirrhosis and cardiac insufficiency. In this subset of patients, lymphovenous anastomosis restores lymphatic circulation, reduces interstitial edema, and improves hepatic microcirculation and cardiac output.

Currently, minimally invasive treatment modalities are the first treatment of choice if conservative treatment fails. Therapeutic lymphangiography can be performed successfully in different sites of lymphatic leakage, such as chylothorax, chylous ascites, or lymphatic fistulas due to its known irrigating effect of the contrast medium lipiodol. Alejandre-Lafont et al[12] reported an occlusion of the lymphatic leak in 70% if drainage volume was less than 500 mL/d. Even if lymphangiography fails, the location of the leak has been identified and surgical intervention can be planned. Percutaneous TD embolization is a further reliable minimally invasive procedure and has similar success rates of 71% with minimal complications.[11] However, its success rate is related to the presence of, and the ability to visualize and puncture, the cisterna chyli that is present in only 52%.[33] Indeed, the cisterna chyli was absent in our patient and interventional sclerotherapy could not be performed.

In conclusion, lymphovenous anastomosis of TD is a feasible and safe technique to treat TD lesions. Compared with techniques that achieve a total closure of TD, lymphatic circulation can be restored. If the TD lesion occurs after neck dissection, it usually is accessible by surgery and surgical exploration, and subsequent supermicrosurgical repair may be a feasible option in many cases. In particular when interventional sclerotherapy is not possible because of the high variability of the TD and/or absence of the cysterna chyli or a wound breakdown necessitating surgical revision occurs, it may be a valuable option.

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